REMR TECHNICAL NOTE HY-MM-1.1

ELIMINATION OF ADVERSE APPROACH FLOW CONDITIONS USING A COMPUTER MODEL

PURPOSE: To describe a computer model that can help in the development of measures to eliminate unfavorable flow conditions near hydraulic structures.

APPLICATION: The STREMR code is suitable for computing the details of subcritical, two-dimensional approach flow for shallow water (plan-view calculations) and for deep water (elevation-view calculations).

LIMITATIONS: The STREMR code cannot simulate three-dimensional phenomena such as secondary flow, nor can it simulate critical phenomena such as hydraulic jumps. Except for a very low Froude number ($Fr < 0.1$), the code predictions are valid only for the steady state.

PROBLEM: Adverse approach flow can accelerate the need for repair, increase the cost of maintenance, and reduce the effective life of a structure. In many cases it is cheaper to modify the approach than to pay the long-term costs that would result from continued operation under existing flow conditions. The modifications, however, must achieve the greatest benefit with the simplest and least expensive remedial measures.

BACKGROUND: In the past, each modification under consideration was usually tested in the laboratory with a physical model. The expense of model building and testing often limited the number of alternatives to be explored. Now, with the widespread availability of computers, it is practical to replace much of the initial testing with computer simulation. Even the refinement of modifications can now be done by iteration between computer simulation and physical model.

REMEDY: A computer program has been developed that will allow engineers to simulate complex approach flows with relative ease. The STREMR code represents a finite difference numerical model for two-dimensional, depth- or width-averaged flow with boundaries of arbitrary shape. To investigate various ideas for alleviating unfavorable flow conditions, the user may change any of the following constraints at will:

a. Shape of boundaries (bank lines).

b. Vertical or lateral topography.

c. Friction (Manning's "n").

d. Piers and piles.

e. Dikes and training walls.

f. Vanes and berms.

g. Inlets and outlets.

h. Islands.

i. Submerged structures.

By trying different options in the computer model, the engineer can accomplish in a few days what might take months to accomplish with a physical model.

After the preliminary approach modifications have been screened by trial and error on the computer, model building and laboratory testing can begin. If new ideas arise from the physical model results, the computer model can be used to study further variations in the approach specifications. After each series of physical tests, the modeler can return to the computer to test new refinements. This back-and-forth process should continue until an acceptable set of approach modifications has been established.

PERSONNEL REQUIREMENTS: A single user can learn to operate the STREMR code with 1 to 3 weeks of concentrated training. Aside from a sound knowledge of hydraulics and fluid mechanics and a rudimentary grasp of FORTRAN, no special expertise is required. Previous experience with finite difference calculations will certainly be helpful, but it is not a prerequisite.

EQUIPMENT: The STREMR code is written in FORTRAN77. A compatible mainframe or minicomputer with at least 300,000 words of core memory is necessary for its execution.

COST: The cost of execution depends upon the computer used, but a typical cost would be about $50 per simulation for a mainframe available commercially to the Corps of Engineers. This cost represents computer time only; it does not include other considerations such as labor costs for code setup and data input.